THE ALL-INDIA VILLAGE INDUSTRIES ASSOCIATION

PALM GUR

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WARDHA C. P.
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Preface to the 2nd Edition

Since the publishing of the first edition in 1938, a great deal of information has been collected from the field work conducted by the A. I. V. I. A. at its headquarters in Wardha and also from other sources. This fresh matter has been incorporated in the present edition. An attempt has also been made to present the different items concerning the industry, as they are required to be tackled by a prospective palm gur maker in the rural tracts.

We are indebted for much valuable information, to the books mentioned in the bibliography, as also to public institutions, various departments of the Government, and workers who have kindly furnished us with information available with them.

1-6-45
Maganvadi,
WARDHA
(C, P.)

GAJANAN NAIK

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"I am always strongly in favour of Palm Gur. Where there are palms every one should have the liberty to manufacture it. This, together with the gur made from cane juice, can meet our full requirements. And I hold that Palm Gur is superior to cane gur."

Mahabaleshwar,
29-4-1945,

M. K. Gandhi.

PALM GUR

I INTRODUCTORY

(i) Characteristics of Palm Gur

The sweet sap of any sugar yielding palm, when boiled to 118° to 120°C. temperature and allowed to cool, solidifies just as the juice of the sugar-cane. This stuff is known as Palm Gur or jaggery. Sometimes the boiling is stopped at 110 to 115°C in order to obtain semi-solid gur which is called Rab.

Palm gur is as crystalline, bright and hard as sugar-cane gur and has a peculiar flavour. It can be used as a sweetening agent in the preparation of different dishes instead of cane gur.

Palm gur is nutritious as it contains important mineral salts like potassium, phosphorus, calcium etc., which can be easily assimilated and are essential for human growth.

The technique of making palm gur is quite simple and can be picked up easily.

Palm gur making is an ancient village industry continued to this date in India and is a source of main and subsidiary income to thousands of villagers.

(ii) Antiquity of the Industry

"The sap of the palm furnished the material for sweetening purposes, but the beginning of the knowledge of the palm as a sugar producer lies hidden in the unrecorded fields of antiquity. Hindu authors have traced the palmyra back to as old as four thousand years according to their reckoning and

the making of sugar from this palm has been practised from times immemorial". (*Sugar Producing Palms by N. E. Fealy, U. S. A.*).

"Another ancient writer has said in a paper read before the Asiatic Society in 1688 - "The Coconut palm is alone sufficient to build, rig and freight a ship with bread, water, oil, *sugar* and other commodities". (*The Useful Plants of India* by Col-Heber).

(iii) Extent of the Industry

[a] *World Production* :

According to Mr. August von Watchel the relative figures of sugar produced in the world from different sources were :—

[i]	From Sugar-cane	...	90	lakh tons
[ii]	„ Beet	...	80	„ „
[iii]	„ Date Palm	...	1½	„ „
[iv]	„ Maple	...	5	„ „

(*Journ. Ind. & English Chemistry,* May 1911)

[b] *Indian Production* :

"Mr. Noel Paton gives an estimate of the palm gur produced in India as 4 lakhs and 80 thousand tons, out of which 1¼ lakh tons are annually produced in Bengal and Assam. The total output of gur in India may be put at 30 lakh tons. Thus it would be seen that roughly 17% of India's sugar is produced from palms". (*Notes on Sugar in India 1911*)

"A careful enquiry by the Government of India in 1889 showed that 1,68,262 acres were under palms connected with sugar supply. If we take two and a third tons of gur a safe

figure, as the yield of sugar per acre, we should get a total yield approaching that of Noel Paton's estimate." (H E. Annet)

"The palm sugar producing districts of Upper Burma export annually about 36,500 tons sugar presumably as gur".

(*Agri. Journ. of India*, Oct. 1911, P. 325)

The annual value of palm jaggery bought by a single Madras firm for refining was more than Rs. 15/-lakhs" (*Indian Agriculturist Vol. XXV 1900 P. 375*). At Rs. 4/- per maund this would be roughly 16,000 tons.

"In Jessore district (Bengal) alone there were in 1900-1 117 native sugar refineries with an outturn of 2,35,000 maunds valued at 15 lakhs (*The Imperial Gazetteer*, *Vol. XIV* P. 96) This is 6,500 tons and would require 16,250 tons of gur for its production."

The total number of palms of all kinds tapped for sugar making in the following Madras districts of Godavari, Kistna, South Kanara. Malabar and Tinnevelly was :

Year		No. of palms
1906- 7	...	26,36,655
1907- 8	...	25,88,410
1908- 9	...	11,33,139
1909-10	...	19,34,820
1910-11	...	23,42,446

Messrs, Parry & Co. purchased palm gur for their refineries as under :—"

Year		Gur tons
1908- 9	...	25,400
1909-10	...	29,000
1910-11	...	36,1000

(H. E. Annett)

II THE SUGAR YIELDING PALMS

(i) Varieties

In the world there are about 2000 varieties of palms. But only nine varieties are useful for sugar production. Some of them are used to a small extent only. The varieties generally used for gur production in India are as under :

(a) *The Coconut Palm* (Cocos Nucifera)

Hindi—Nariyal; Bengali—Narikel; Gujarati—Nariel; Marathi—Mad: Narali; Malayalam—Tenga; Tamil—Tangai; Telugu—Tenkayichettu ; Kanarese—Tenginamara.

(b) *The Wild Date Palm* (Phoenix sylvestris)

Hindi—Khajur ; Bengali—Khejur ; Gujarati—Khajuri ; Kanarese—Ecchalamara ; Malayalam—Katenth ; Marathi—Shindi ; Tamil—Perichhu ; Telugu—Ishan-chedi.

(c) *The Palmyra Palm* (Borassus Flabellifer)

Hindi—Tad; Bengali—Talgachh; Kanerese—Talimara; Gujarati—Tad; Malayalam—Talam; Marathi—Tad; Tamil—Panai-Maram; Telugu—Tati.

(d) *Indian Sago Palm* (Caryota Urens)

Hindi—Mari; Kanerese—Baini; Gujarati—Shivjata; Marathi—Bherla Mad; Malayalam—Eerampanna; Tamil—Utalipannai.

(ii) Growth and spread of the Palms

(a) *Coconut Palm* :— This palm thrives best in the humid and temperate coastal regions. It is cultivated in gardens and requires nursing, especially regular watering and manuring. Usually it produces spathe at the age of seven in most favourable conditions or when it is 10 to 15 years old

depending on the seed, climate and soil. It throws out a spathe every month. Its life ranges from 80 to 100 years. Dry and hot inland tracts are not suitable for its healthy growth. In India the coconut gardens covered 13,87,773 acres in 1932-33.

(b) *Date Palm*:—This palm is tolerably common throughout India. It thrives in moist lands. It grows wild and has also been cultivated in many parts. It is not the same palm as the one from which dates are obtained (Phoenix Dactylifera). The life of the palm is 40 to 50 years. The tree is fit to yield sweet sap when 5 to 6 years old. It requires no special nursing.

(c) *Palmyra*:—The most congenial places for the growth of this palm are low sandy plains, scarcely above sea level and getting at least one of the Monsoons. Still it grows in almost all the provinces of India. Generally it grows wild but it is also cultivable. The inflorecence appears about the tenth or fifteenth year of its age, when the tree can be tapped for sap. Its life is more than a hundred years.

(d) *Sago Palm*:—This palm grows wild, but it is also cultivated. It becomes tappable when 15 to 20 years old. The tree is said to be a native of the mountainous regions of India, especially on the Coromandal and the Malabar coasts and in Travancore, Mysore and in Ceylon. In good ground the tree lasts about ten years after being tapped, and for four or five years in poor ground.

TABLE I

PROVINCIAL DISTRIBUTION OF THE PALMS

S. No.	Province	Coconut	Date	Palmyra	Sago
1	Assam	A	P	P	P

2	Bengal	G	G	G	P
3	Bihar	A	P	P	A
4	Bombay	P	P	P	P
5	C. P.	A	GR	P	P
6	Madras	G	G	G	G
7	N. W. F. P.	A	P	A	A
8	Orissa	P	GR	GR	P
9	Punjab	A	P	A	A
10	Sind	P	P	P	A
11	U. P.	A	GR	GR	A

In the above : A = Absence

G = Used for gur making (Establishad Industry)

P = Presence

GR = Gur making recently introduced.

(iii) Cultivation

Two methods are followed for cultivating these palms— (1) By directly sowing the seeds in desired spots. (2) By growing seedlings in a nursery and transplanting them in proper pits usually after a year from the date of sowing. The sowing and transplanting are done during the rains.

Although watering or manuring is not required for Date, Palmyra or Sago palms, precautions to preserve them ought to be taken. The young plants are much spoiled by cattle grazing which has to be prevented. Indiscriminate cutting of the green leaves of the palms thwarts their growth and adversely affects the yield of juice. Most of these palms, while growing wild, are irregularly spaced. In some cases they are found in thick clusters. The larger the number of trees situated close together, the lesser will be the yield of sap per tree, as the subsistence available from the soil for

each tree will be inversely proportional to the number of trees. Therefore it is advisable to remove the intervening plants of palms where they grow naturally and leave proper spacing between them in order to get an economic yield of juice from the trees tapped. The following table will be useful either for planting or cleaning palm topes.

TABLE II

SHOWING PALMS PER ACRE

S. No.	Palm	Spacing	Trees per acre
1	Date	10' x 10'	500
2	Palmyra	10' x 10'	500
3	Sago	15' x 15'	193

The Date, Palmyra and Sago palms, being of wild growth, do not require good agricultural fields. They are easily grown on non-agricultural waste lands in the plains, or on hill slopes. Also they are conveniently raised on the bunds of fields without harm to crops—especially the Date and the Palmyra.

(iv) Reserving of Palms

Besides gur making, these palms are useful for many other purposes. A number of useful articles *viz.* mats, brooms, ropes, baskets etc. are made out of them. The petioles and leaves are used as fuel and for thatching. At present people recklessly help themselves to these for getting the raw material to make such articles, without caring for the growth and preservation of the palms, as a source of sugar. It will be a paying precaution to reserve a requisite number of palms in each village or a group of adjoining villages for satisfying the local sugar needs. The state and people ought to co-operate in reserving palms as they do timber trees.

III TAPPING

(i) General Aspects

The process of artificial extraction of sweet sap (nira) from the sugar yielding palms is called tapping. The word is derived from the peculiar sound produced while the coconut spathe is beaten with a wooden ruler to rupture the cells and stimulate the stalk to yield a flow of sap.

Nira is extracted from the spathe of the Coconut, Palmyra and Sago palms and from the top-most tender part of the trunk of the Date Palm.

The process of extracting Nira is not the same even for the same kind of palm throughout India. It has provincial and local variations. Thus the Bengali method of tapping Date, Palmyra and Coconut is different from the Bombay one. In Bengal itself the 24 Paraganas method of tapping Date palms is different from the Dacca one.

Tapping is a skilled art. It takes at least six months to learn it and long practice for perfection.

(ii Coconut Tapping

Selection ;— Trees, which have begun to bear fruit and have two or three spathes, are generally selected. The spathes should be allowed to mature to their full growth (about 2 months) before they are fit for tapping. Such spathes should not, however, be allowed to open out. Tappers feel the spathes with their hands and when they begin to feel something like enlarged glands on the spathes, they declare that such spathes are fit.

Preliminary Process:— The Spathe is rubbed or massaged by hand from the bottom to the tip twice a day, both morning

and evening, for a week. Then with coconut fibre, the spathe is tied round tightly from the bottom to the tip in rings two inches apart. The fibre used is stripped from the stem of the leaves. After this the tip of the spathe is transversely cut with a sharp knife and it is beaten all round with a wooden ruler from the bottom to the tip. This tapping and slicing is done morning and evening for about five days. By this time nira begins to drip from the sliced end of the spathe. Till this day the sliced end is kept covered with coconut leaves or the juice of certain plants to protect it from exposure to sun and attack of flies and insects. A small mud pot is attached to this end of the spathe to collect the nira. At any one time more than one spathe can thus be operated upon. Since the coconut tree puts forth a spathe every month, it can be tapped at any time during the year. A spathe yields nira from 27 to 32 days.

In drier localities tapping should be confined to six months only *i. e.* during the wet season.

In October and November the flow of nira is at its minimum, while in May and June it reaches the maximum. Commencement of tapping in April is the best.

Trees which produce a large number of nuts yield a large quantity of nira, while small bearers yield small quantities.

A Benificial after-effect :

Tapping improves the yield of nuts of trees. This improvement lasts for about four years after tapping is discontinued. As nira is obtained by slicing the spathes, which are the source of the nuts, no nuts are yielded during tapping unless some spathes are left untapped for growing nuts. It is advisable to tap poor bearers for a season or two and then allow them to produce nuts. The tapping should be again resorted to when the yield begins to fall.

(iii) Date-Palm Tapping

The methods differ in different provinces in regard to the process of slicing the tender topmost part of the trunk of the tree just below the growing region. They can be fully described only in an exclusive treatise on tapping. The broad outline of the tapping operations is as under.

The tree is almost always tapped on the East and the West side. If it is tapped on the Northern or the Southern side, the surface to be exposed for tapping will not dry rapidly and putrefaction may take place.

All the old leaves of the tree on the half side opposite to the other half surface, which was tapped the previous year, and those higher up for a height of about 1½ ft. and almost extending upwards to the central growing shoot of the tree, are cut off with a hatchet or a heavy sickle. The leaves on the opposite side of this cleaning are not to be removed. Then the basis of the petioles and sheaths of the cut leaves are carefully removed. After this the outer zone of the loose soft tissue is pared off in long slices with a light chisel or sickle, leaving only a thin covering of it over the sap-supplying inner zone. Every care must be taken not to expose this inner tissue at this stage, otherwise the tree is sure to rot and die. Then the tree is rested for about 8 days. During this period the fine covering of the soft tissue gets a little hardened and begins to crack. The second operation is of removing this thin covering, taking precaution to avoid cutting into the inner zone, which must merely be exposed. Again the tree is rested from 10 to 15 days. After this rest, regular slicing of the sap-supplying zone is started with a sharp chisel or sickle. Two pieces of date leaves or a bamboo spout is fixed in the trunk, just at the bottom of the cut, for leading the juice oozing from the cut into the mud pot

attached to the trunk with a rope. This slicing is continued at stated intervals till the tree ceases to yield an economic quantity of juice. A tree can be tapped for about three months. The trees are sliced only once a day in the evening when they are tapped, unlike the other palms, which are tapped thrice a day.

(iv) Palmyra Tapping

Both the male and the female Palmyras are tapped when they put forth spathes. In the case of the male tree, the juice is drawn from the inflorecence only, while from the female it is drawn either from the inflorecence or from the ripe fruit. The tapping season differs in different localities according to the local flowering period of the palmyra. When the finger-like flowering stalks have come out of the spathe completely and attained a certain degree of maturity, they are fit for tapping. If too tender or too ripe spathes are tapped, juice does not flow easily and copiously. Therefore the selection of the spathe at the proper time of maturity is important. This also applies in case of the Coconut and the Sago Palms. The stalks are massaged as in the case of the Coconut. The Bengal tappers select a little tender spathe of the male and do the massaging with hand, while in other provinces the stalks are pressed gently by means of improvised wooden tongs. In the female trees, when the fruits are in a rudimentary stage of development, the stalk bearing the undeveloped fruits is rubbed with the fibrous appendages at the base of the spathe to prevent the growing of fruits. This diverts the juice from going to nourish the fruits. In some places the stalks are beaten lightly all round from the base to the tip with a wooden or iron ruler. The pressing and tapping are done lightly in the case of the male trees and hard in the case of the female ones. This squeezing and

tapping is done for the first three or four days. The tip of the stalk is transversely cut off in thin slices, twice a day, morning and evening. Within three or four days sap begins to trickle from the sliced end of the stalk. As a number of stalks come out of one male spathe, they are tied in convenient bunches and an earthen pot is attached to each bunch to collect nira. Both male and female trees put forth a number of spathes at a time. More than one spathe can be worked at a time, and a number of small mud pots attached to the same tree. In the case of the Coconut or the Sago, at the most three or four spathes are worked simultaneously, while in the case of the Palmyra even a dozen spathes can be operated at one time. The slicing of the stalks has to be done regularly and punctually till the stalks are exhausted. In some areas nira is also extracted from the main stalk bearing the spathe, when the flowering stalks are completely sliced off. If the yield shows signs of premature diminishing, the stalks are occasionally squeezed or beaten all round. In some tracts the slicing is done thrice a day, morning, noon and evenining, while in others only in the morning and evening, or only once in the evening. The Palmyra puts forth spathes twice a year, both male and female. Those put forth in the hot season yield more sap. In the case of the female trees nira is also drawn from the fruits. The spathes are allowed to develop and bear fruits, and the fruits when sufficiently ripe, are tapped and regularly sliced for obtaining nira. Tapping of female spathes and fruits can be conducted on the same tree. When the season starts, a few spathes are tapped before they can bear fruits, while others are left unoperated to develop fruits. By the time the operated spathes are exhausted the fruits are ready for tapping and thus nira drawing can be prolonged. But this is not possible in the case of male trees.

(vi) Sago Palm Tapping

The spathes of the Sago Palm are long and hang like the trunk of an elephant. The selection of the spathes is done in very much the same way as that of the Coconut spathe. It requires much skill to make the spathes yield sap. They require a good deal of squeezing and rubbing for more than a month, before nira can be made to drip. During this period of massage the spathe is tied round with fibre in order to prevent its opening. The tip is cut off and kept closed with tin plate to protect it from the attack of rodents. When nira begins to drip, a mud pot is tied to the sliced end of the spathe. Then the spathe is regularly sliced thrice a day. It yields nira for about four months. More than one spathe can be worked at a time. The Sago Palm usually puts out spathes in summer and yields nira for about 10 months. Its best yield is from November to April

(v) Resting in Tapping

(a) *Intermittent Rest* :— In the case of the Coconut, Palmyra and Sago, the slicing of the spathes has to be done twice or thrice a day (morning, noon and evening) without fail to ensure copious yield of nira. To miss even one slicing is rather harmful. A spathe is rendered useless if the cut is not renewed for 3 to four successive days. Thus the slicing of the spathes of these palms has to be done regularly till they are exhausted. On the contrary, it is very essential to suspend the scraping of the cut surface of the Date palm during the tapping period regularly. If the scraping is carried on daily, the quality of nira deteriorates and the health of the tree is also spoiled. The duration of the intermittent rest given to the trees differs in different localities, from one day to six days. The most convenient period of rest seems

to be two days. Thus a tree is tapped for two consecutive days and the scraping is suspended for the two following days. This course of alternate tapping and resting is followed till the tree ceases to give economic yield of nira. In humid tracts the intermittent rest may be extended to four days without harm. According to this a tree is tapped for two consecutive days and rested continuously for the succeeding four days. In case the system of two days' tapping followed by two days' rest is adopted, which should be in dry areas, the total number of Date trees required for each tapper will be 60 if he can tap 30 trees per day; while working the other method of 2 days' rest and four days' tapping, 90 trees will be required so as to enable the tapper to tap 30 trees per day, as shown in table III.

TABLE III

(A) First System of Resting Date Palms

(2 Tappings & 2 restings; Groups A & B, 30 trees each, Total Trees 60)

Day	Tapped	Rested
Monday	A	B
Tuesday	A	B
Wednesday	B	A
Thursday	B	A

(B) Second System of Resting Date Palms

(2 Tappings & 4 restings; Groups A, B, C; 30 trees each; Total Trees 90)

Day	Tapped	Rested	Rested	Rested
Monday	A		B	C
Tuesday	A		B	C
Wednesday	B	A		C
Thursday	B	A		C

Friday	C	A	B	
Saturday	C	A	B	
Sunday	A		B	C
Monday	A		B	C

Under the first system each tree will be tapped for 45 days in a tapping period of 90 days, while in the second system each tree will have only 30 tappings in the same period.

The first system is suitable for dry areas because the scraped portion of the tree can get dry sooner, while in a moist climate the drying will take a longer time. So the second system will suit wet tracts. Moreover, if the portion to be scraped is dried up too much, thick slices of the sap-supplying zone have to be scraped for making the tree yield nira, and this way the yielding period of the tree is shortened. The yield of nira is also lessened (Table IV). The trees were tapped in a dry area, Sevagram (Wardha C. P.) in 1939-40 season, Trees in group A were tapped for 3 consecutive days and rested for the succeeding three days, while trees in group B were tapped for one day and rested for the following two days.

TABLE IV

EFFECT OF RESTING ON NIRA YIELD

System	No. of Trees	Total nira	Average per tree
A) 3 days tapping & 3 days rest	41	8198 lbs	198 lbs
A) 1 day tapping & 2 days rest	51	6754 lbs	132 lbs

(*Totals of nira obtained in Jan.* 1940 at Sevagram)

Thus it will be uneconomic to tap the tree only once after resting it for one or more consecutive days. If continuous tapping for several days is conducted the quality of nira deteriorates steadily. Nira yielded by a tree on the first tapping after rest is of the best quality, and the one got on the second tapping is better than from the 3rd or subsequent tappings. Gur made from the nira obtained on the 1st and 2nd cut after rest is more crystalline and sweet. Making of gur from nira of 3rd or subsequent tappings is bothersome. It does not set easily as it contains less amount of sucrose. Therefore the most suitable mode of resting the date trees in dry areas is two days' rest followed by two days' tapping.

(b) *Fallow period* :—All the palms are not tapped year after year. Except in Bengal the Date Palm is usually given rest every alternate year as the tree will be exhausted, and even destroyed early, if tapped annually. Since under the Bengal method the scraping is only superficial and not so deep as in the other provinces, the trees there can be tapped year after year without any fallow period. The Coconut is tapped every alternate six months and allowed to grow nuts during the other six months. In some parts Palmyras also are rested every alternate year, but in most places they are tapped annually. Sago Palm is tapped year after year as its yielding life is very limited.

(vii) Precautions in Tapping

(a) *Regularity* :— The daily slicing in case of the Coconut, Palmyra or Sago ought to be done at regular intervals just like the milking of a cow. Irregularity tells badly upon the yield of nira.

(b) *Slicing & Scraping* :— The sliced or scraped surface should be left very even so that the maximum number of pores can be opened for facilitating free and copious oozing of nira.

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It is also imperative to keep the cut surface perfectly clear of all lather which is apt to generate putrefaction of the surface and allow speedy fermentation of the nira,

(c) *The Tapping Tools* :— The tools, knife, chisel or sickle, used for slicing or scraping ought to be kept clean and sharp. A blunt knife cannot make a sharp cut.

(d) *Spouts* :— The pieces of palm leaves or spouts fixed in the spathe or the trunk of the palms should also be thoroughly cleaned daily and changed occasionally for avoiding fermentation of nira.

(e) The scrapings or slicings must be carefuly made thin so that the trees can be tapped for a sufficiently long period. If indiscriminately thick slices are pared off, the Date palm trunk, the sap-supplying zone, will be exhausted soon. Also if thick slices are cut off from the spathes of the Coconut, Palmyra or the Sago, the spathes will be exhausted too early. Consequently the tapping period will be shortened and the quantity of nira obtained per tree will be less.

(f) *Pots for Nira Collection* :- The nira receptacles attached to the spathes of the Palmyra should be light, as the spathes are not so strong as those of the Coconut or the Sago. Heavy pots obstruct the free flow of nira towards the cut end of the spathe and thereby the yield is lessened. Light pots are also handy for lowering.

(g) *Careful Selection* :- Though every sugar yielding palm is capable of yielding nira, the trees have to be diligently selected. It will not pay to tap rickety trees. Robust trees, having big girthed trunks and plenty of leaves, are preferable.

(viii) Palm Climbing

In order to tap the palms it is necessary to climb them. Climbing a palm is a problem as the tree has no branches.

Various contrivances have been adopted in different localities for the purpose.

The Date palm :— The Date palm has got shoots of the cut off petioles on its trunk, which serve as steps. A leather rope or a rope made of palmyra fibre is used for the hands, and after reaching the top of the tree, the tapper rests his body on it by encircling his waist and the tree trunk with it, while he taps the tree with his hands. Except in Bengal the tappers use the rope while climbing. The Bengal tapper climbs the tree like a monkey. He uses a jute rope for reclining while tapping.

The Coconut palm :— The South Indian tapper uses a loop of coir string for the legs while climbing. The tappers in Bombay make superficial cuts on the trunk to hold the toes. These serve as steps. Such cuts once made last throughout the life of the tree. The Bengal tapper ties a strong bamboo [with its branches cut off 5 inches away from its body] parallel to the trunk. This bamboo serves as a miniature ladder.

The Palmyra palm :— The Madras tappers use a long rope of palmyra fibre for the hands as in the case of the date palm in some districts. In other places a loop of coir rope or palmyra fibre is used for the feet only. The Bombay tappers, in some localities, make cuts on the trunk similar to those of the coconut and use a coir loop for the hands.

The Bengalis always use a bamboo as for the Coconut palm.

The Sago palm :— In all places bamboos or poles are tied to the trunk as the Bengalis do for the Coconut or the Palmyra, because the girth of the trunk of the Sago palm is too big for holding on to in the loop of the hands.

Out of the aforesaid methods the Bombay method of making superficial cuts and the Bengal method of using

bamboos are convenient. Suitable bamboos are available in forest vicinities and wherever circumstaces are favourable, the Bengal system should be adopted. The Bombay method is cheap and can be adopted everywhere. By these two systems the climber has to put in much less physical effort than by the other methods.

(ix) Tapping Season

Seasons for tapping the Palms differ according to local climatic differences. Winter is the most suitable season for the Date palm. The Coconut, Palmyra and Sago are tapped when they put forth spathes. The Coconut yields more in the wet season while the Palmyra in the hot season. The season is also determined by the local flowering period of each kind of palm. It is said that preparatory to the production of flowers and seeds the parenchyama in the trunk of the palms is full of starch, which at the time of flowering is transformed into sugar.

IV. NIRA : THE RAW MATERIAL

(i) Origin

The sweet sap yielded by any of the sugar yielding palms on tapping is called nira. The word is derived from Sanskrit 'nir', meaning water, since it is colourless, transparent and harmless like water. It has a pleasant, sweet taste. It is a refreshing and nutritious, cool beverage.

(ii) Constituents of Nira

The following chemical analysis of the nira of different palms will give an idea of the utility of nira.

TABLE V

ANALYSIS OF NIRA

(A) Coconut palm Nira

(1)	Moisture	84.72%
(2)	Protein	0.10%
(3)	Fat	0.17%
(4)	Mineral matter	0.66%
(5)	Carbohydrate	14.35%

(Nutrition Research Laboratories, Coonoor)

(B) Date palm Nira

(1)	Sucrose	10.62%
(2)	Reducing Sugar	0.96%
(3)	Ash	0.24%

(4) Albuminoids	0.30%
(5) Co Na Co 3	0.65%
(6) Water	87.20%
(7) Undetermined	0.63%

(H. E. Annet)

(*C*) *Palmyra Nira*

(i) Moisture	86. 1%
(ii) Protein	0. 3%
(iii) Fat	0 02%
(iv) Minerals	0. 4%
(v) Carbohydrates	13. 2%

(*K. Mitra I/C Nutrition Research Scheme, Patna*)

Though the analysis of Sago palm Nira is not available, this nira may be presumed to be similar in almost all respects to that of other palms.

(iii) Alcohol in Nira

The foregoing chemical analyses show that alcohol is not at all present in nira, So nira is not intoxicant even if consumed in any quantity as a beverage. Actual experiments at Sevagram and other places have corroborated this fact. Nira has been habitually, as well as occasionally, consumed as a beverage in small and big doses by persons of both sexes, different ages and occupations without leading to intoxication. They found it health-giving.

(iv) Preservation of Nira

(a) *Fermentation* :— Nira, as it trickles from the palm, is sweet and contains only sucrose. But due to atmospheric temperature the sucrose gets inverted and bacteria from the atmosphere get into the receiving pots. Thus if nira is left uncared for it is liable easily to get fermented and become converted into intoxicant toddy.

Nira cannot he obtained in large quantities in a short time as cane juice. It merely oozes out of the cut or scraped portion of the palm spathe or trunk. It does not flow but trickles into the receiving pots. So it takes 12 to 14 hours to get a sufficient quantity from a palm. Therefore it is quite essential to add some preservative to the pots to keep the nira in tact for such a long period.

(b) *Lime: the best preservative* :

Age old practice continued to this day in Bengal and Madras, as well as modern scientific research, have proved lime to be the best preservative for nira.

Slaked lime is used for the purpose. A solution of lime should be prepared in water. It should be thick and put into the pot just before attaching it to the tree. The exact quantity of lime for each pot cannot be prescribed universally. The lime should be enough to preserve the nira collected in the pot. Only the tapper can know the quantity yielded by a spathe of a tree and adjust the quantity of lime. By practice one learns this adjustment.

There is a practice of making a thick paste of lime and smearing it internally to the nira pots daily with a stick or brush. This system is defective for the following reasons :—

(1) The quantity of lime added to a pot thus cannot be ascertained. (2) The lime gets dried before nira trickles into the pot and so it cannot easily act on the nira. (3) The lime gets stuck to the pots and it is a daily bother for the tapper to remove it while cleaning the pots. (4) He has to rub out this lime, and thereby the durability of the pots is shortened. (5) Lime is wasted because much more is added to the pots than needed.

On the other hand if a solution of lime is put in the pots, all these defects can be avoided. Lime does not get dried and so mixes well with nira. The solution can be added according to measure. It never sticks to the pot and the cleaning becomes quite easy. All the lime comes out along with the nira. This handy method has been successfully worked on 220 trees of Date palm at the Tuljapur centre (Wardha. C. P.) in 1941-42 season.

The lime, when in solid condition, should be in hard balls. When it is exposed to air, moisture acts on it and it is rendered into powder which is not so alkaline as the hard balls. Such powder is useless for nira preservation. If the hard balls are soaked in water, they dissolve and form a milk white solution which is strongly alkaline and serves the purpose of preservation best. But this solution must not be allowed to dry through evaporation. Care should be taken to add water to it at intervals. It is always preferable to prepare this lime solution enough for a season. Meticulous care should be taken to keep it watery. Lacquered earthen pots are superior for this purpose to ordinary porous ones.

In case pots attached to the palms are not replaced, a requisite quantity of lime solution should be added to each pot whenever nira is emptied from it. No pot without lime should ever be attached to a palm.

(c) *Chemical effect of lime ;*

Numerous bacteria, yeasts and moulds, are formed in untreated nira. These organisms secrete non-living ferments which are capable of changing the cane sugar present in nira into less valuable reducing sugar. Preservatives like formalin or smoke can check the development of living organisms but the action of non-living ferments such as invertase, which change cane sugar into reducing sugar, cannot be arrested by them. Lime on the other hand, being strongly alkaline, can ckeck the action of invertase ferments besides the action of living organisms, as it is a good sterilizer. Lime not only preserves but improves the quality of nira, by destroying the reducing sugar. Annet found that the percentage of invert sugar in Date palm nira was reduced from 1.56 to 0.80 when preserved with lime.

(d) *Proper liming :*

As the liming has to be done in anticipation of the quantity of nira that collects in the pot during the succeeding 12 hours after tapping, great care must be taken in liming. Both underliming and overliming are detrimental. Underlimed nira exhibits signs of slight fermentation, has a hazy appearance and a little sour taste. The gur prepared from such nira becomes sticky and stingy. It does not become crystalline. It is soft and congeals slowly. It has a low keeping quality.

Overliming gives to the nira a milky appearance. The colour of the boiling syrup of such nira darkens indicating destruction of sugar. It crystallizes slowly. The gur is soft and inferior.

Properly limed nira is bright and opaque, the lime settling at the bottom. The jaggery has good crystals and an attractive colour.

(c) *Treatment of Receptacles :*

The mud pots attached to the palms for receiving nira ought to be cleaned daily. Usually the pots are porous and so nira is absorbed by them. Mere washing with cold or scalding water only cleans their superficial sides. The absorbed nira cannot thus be got rid off, unless the pots are sterilized over fire. This is rather expensive and laborious. It is advisable to use lacquered earthen pots instead of porous ones. The ordinary pots can be lacquered at home at negligible cost. These lacqured pots do not absorb nira and therefore need not be sterilized but washed with ordinary warm water and dried in the sun.

In Madras, the palm gur makers do not change the pots. They wash the pots on the top of the tree with a little cold water they carry with them. For preserving the nira from fermentation they overlime the pots, and consequently their gur is proverbially black and limy in taste. In Bengal the palm gur makers have cultivated the practice of changing and scrupulously cleaning the pots. They make gur from Date palm nira without even using lime in winter. They use a small quantity of lime for preserving Palmyra nira. The result is their jaggery is of a pleasant taste and has an attractive colour. The Bengal system, though a little more laborious, is superior and commendable, especially when the gur is meant for direct consumption and not for sugar refineries, as it is mostly in Madras. A double set of pots should be kept to facilitate daily replacing. The pots are usually replaced while tapping the trees in the evening. Cleaned and sundried pots are carried by the tapper to the top of the tree. The pots attached to the palm on the previous day are removed and are replaced by the cleaned pots. At this time a requisite quantity of lime solution is put into each empty pot. In the

morning the nira is emptied into a spare pot carried to the tree top by the tapper, lime is added as in the morning but the pot is not replaced. The reason for not replacing the pots in the evening is that as the night is cooler than the day, the pots are less likely to be spoiled.

(v) Keeping Quality of Nira

(a) *Unlimed Nira* :— On very cold nights it is possible to collect nira unfermented, even without the use of lime. The pots, without being treated with lime, are attached late in the evening and lowered early in the morning before sunrise. This untreated nira can keep well hardly for an hour after collection. The Bengalis draw Date palm nira in winter in this manner.

(b) *Limed Nira* :— By adding adequate lime to the pots, nira can be collected by day or night, warm or cold, from any kind of palm during the season. It is not at all necessary to lower the pots before sunrise, but can be lowered at any hour.

The lime keeps the nira well for about twelve to eighteen hours *i. e.* if the pots are attached in the evening between 4 and 6 P. M., the nira is preserved till the next day upto 9 P. M. After that the lime is exhausted. If it is desired to preserve the same nira any longer, lime should be freshly added at intervals. Though nira can be thus preserved for a number of days it will lose its natural aroma and taste. At Bordi Research Centre, nira was thus preserved for eight days continuously (1941), but the convenient period for which nira can be thus preserved in consumable condition, is 24 hours after lowering from the tree.

(c) *Sterilized Nira* :— If the unlimed or limed nira collected from the trees is heated to 60°C for about 15 minutes,

it can be preserved for 12 hours more. Of course its natural taste is lost.

(d) *Boiled Nira* :— Instead of sterilizing if the nira is boiled, it can keep for 24 hours more.

(e) *Bottled Nira* :— If sterilized nira is filled in air-tight bottles, it is said to last for months.

(vi) Nira vs. Toddy

There is a marked difference between nira and toddy, though the primary origin of both is the same *viz.* sugar yielding palms.

Nira is nature's gift, as any other beneficent fruit drink. If consumed as a beverage it has no harmful effect on the system. Since it contains no alcohol, it does not cause intoxication. Only from such sweet, unfermented nira, good, crystalline, hard and relishing jaggery can be manufactured.

Toddy is formed when nira is spoiled on fermentation just as curds is formed from milk. It has a white colour and a nasty sour smell and taste like spoiled butter milk. It contains about 5% alcohol. If this toddy is boiled like nira, the residue will not be standard jaggery but some sticky, sour stuff. Unlike nira this toddy is intoxicant. Toddy can never be obtained directly from the palms. The juice that trickles even in the toddy collecting pots attached to palms is nira. The pots are not cleaned or sterilized or even limed. They are ripe with ferments. As soon as the nira from the tree drops into the pot it is converted into toddy. It is erroneous to suppose that toddy oozes directly from the body of the palm. Just as the cow yields only sweet milk, and never sour butter milk, the palm yields sweet nira and never the fermented and intoxicant toddy.

"Khava" can be made only from sweet milk and not from butter milk. Similarly gur can be made only from nira and never from toddy.

(vii) The Day Collections

The nira which collects in the pots attached to the palms during day time is lowered in the evening. It is not necessarily boiled into gur the same evening, as this is inconvenient. The juice is heated and kept over night, and converted into gur along with the night collections, lowered from the palms in the morning.

Usually in Bengal, only the night collections of the Date palm are utilized for gur making, and the nira dripping during the day is not collected but allowed to go waste, as the tappers there do not lime the pots. By liming the pots, the day nira from Date palms can also be utilized for gur as that of the Coconut, Palmyra or Sago. In some areas in Bengal, they make molasses from the unlimed day nira, which being slightly fermented, cannot be converted into crystalline rab or solid gur. Therefore, wherever only the night nira is used, the pots are attached in the evening when the Date palms are scraped, and they are lowered the next morning, cleaned and treated. The same pots, after treating, are used day after day.

V. CLARIFICATION OF NIRA

(i) Straining

Ants and other small insects, pieces of palm leaves etc., are likely to get in the nira while being collected on the trees. For getting rid of this suspended foreign matter, the nira is strained either through cloth or wire gauze, when it is lowered from the trees.

(ii) Deliming

Part of the lime added to the pots is dissolved and the rest remains in suspension in the nira. The straining does not separate this lime from the nira. If such nira, along with the lime be boiled, the resultant gur has a black colour and salty taste. The excessive lime must be taken out. The suspended lime is removed by a physical process while the dissolved lime is minimised by a chemical device.

(a) *Decanting* :— The cold nira, after the straining, is allowed to stand in tall containers, for about half an hour. The suspended lime settles at the bottom. The clear liquid on top is decanted, the sediment being discarded.

Instead of decanting the cold nira, it may be heated to 50° to 60°C and then decanted as above, when more lime settles at the bottom.

(b) *Filtration* :—Even after decanting some lime particles remain suspended in the nira. To remove them, it is filtered through a sand filter.

(c) *Acidifying* :— Neither straining, decanting nor filtering can help to remove the excess of alkalinity caused by the lime

dissolved in the nira, Some acidic substance, which precipitates calcium soluble in nira, has to be added to achieve this object. Of all the substances alum and commercial superphosphate have been found to be most useful for the purpose. A solution of either alum or the phosphate is made in water. It is added little by little to the nira while it is being heated. Care should be taken not to add so much of this solution as to turn the nira acid. The nira must still remain just alkaline before boiling. The solution is added little by little and not in big doses. Litmus paper is used to ascertain the alkalinity in the nira. If the nira is strongly alkaline, red litmus when dipped into it, at once turns into deep blue. The blue colour fades by degrees, as the alkalinity goes on diminishing by the addition of the acidic solution. At last when the red paper gets a very pale blue tinge, the adding of the acid is stopped. Then the heated nira is decanted and filtered as above.

Ordinarily the professional palm gur makers of Bengal or Madras merely strain the juice and very rarely decant it cold. The more elaborate process of filtering and acidfying is adopted by educated workers only. The more clarified the nira the more attractive is the colour and taste of the resultant gur, The last two processes are a little expensive. Unless the village producers are assured of better prices they are not likely to adopt these refined processes.

VI. GUR MAKING

(i) Boiling

The clarified nira is now ready for boiling. It must be done without delay. The nira is poured into the pan, put on the furnace and quick fire made underneath. Just before boiling, the juice rises up in the pan like milk. In order to allay the frothing, some oily substances such as crushed castor seeds or chips of copra or sweet oil drops, are added to the pan. A dried palm leaf, left immersed into the pan partially, or quick vertical stirring of the boiling nira, also has the desired effect.

(a) *Skimming :—* After the frothing subsides, scum is formed on the top of the boiling nira. It is removed with a perforated ladle. The scum is collected in a small basket, internally lined with thin cloth. The nira strained from the scum is again added to the pan. The scum is useful fodder for cattle,

(b) *Firing :—*A quick and constant fire should be applied. An unsteady fire requires more fuel and time and thereby the percentage of cane-sugar in the resultant gur is also reduced. The fire should be controlled at the fag end, when the boiling liquid is converted into a thick viscous mass. After the syrup has risen up and settled down, the fire must be carefully checked. Excessive heat at this stage spoils the colour and taste of the gur. If the fire is not quite controllable, the pan may be removed from the furnace for a while and again placed. Ashes or water may be sprinkled over the fire to reduce the heat.

(c) *Stirring :—* The viscous mass is constantly stirred with a wooden pardi (ladle) in order to avoid charring. The

stirring must be carried on till the gur is emptied out of the pan.

(d) *Striking the Pan* ;— A small quantity of the boiling viscous mass is rapidly cooled in water, rolled into a ball between the fingers and struck against the side of the pan. This is repeated twice or more till the striking gives a metallic sound. When this stage is reached, the temperature of the boiling stuff is from 118° to 120°C. Immediately the pan is taken off the furnace and the contents poured into a flat cooling receptacle. If the pan is struck at the proper stage no gur clings to the pan when the gur is poured off into the cooling vessel. It should be noted that gur never solidifies in the boiling pan. In the cooling box the gur is stirred once or twice till signs of crystallization are noticed. When it is sufficiently cooled complete crystallization takes place. Then with wooden scrapers it is heaped in the centre of the vessel. Moulds of desired shape, internally lined with wet cloth, are kept ready. The semi-solid crystallized mass of gur is poured into the moulds, where it solidifies into hard gur. The hard blocks of gur are taken out of the moulds after half an hour or twelve hours, depending on the size of the mould.

(e) *Under Heating* :— If the pan is struck off at a much lower temperature than the above, then the gur will remain in liquid form, which is popularly called "Gur" in Bengal and "Rab" in North India. On the other hand, if it is struck at just a little lower temperature, it will neither turn into good rab nor hard solid jaggery. It will be sticky, though it be made from quite unfermented nira. This stickiness is due to the moisture present in the gur due to under-heating. If such gur is slightly heated the stickiness disappears and quite nice gur is obtained. So one must note the difference between stickiness in gur caused by fermentation in nira and the one caused by

under heating. Only the stickiness created by under heating can be remedied.

(f) *Over Heating* :— The gur will be unusually hard and will have a burnt smell and taste if it is over boiled.

(ii) Appliances

(a) *Boiling Vessels* :— Earthen vessels are used by villagers for boiling as they are very cheap and easily available. Much precaution and alertness have to be exercised for making gur of standard quality in earthen pots. As the pots are deep it requires a longer time and more fuel to evaporate the same quantity of nira than in shallow metal pans. Again as the pots are round bottomed, the syrup, while boiling, gets caramelized on the sides unless constantly stirred. But in flat bottomed iron pans such caramelization does not occur,

(b) *The Iron Pan* :— The pan is made of iron sheets. It should be flat and shallow, its depth being not more than 9", the breadth of the pan depending upon the quantity of nira to be boiled. The diameter of the top of the pan should be about half a foot more than the diameter of its bottom. The bottom must be sufficiently thick, about 3/16 inch. If the bottom is thin, the syrup is burnt at the finishing stage. A thin vessel is rapidly heated and rapidly cooled. A thick vessel retains heat and this is necessary, as the boiling viscous mass should be kept at a very low heat at the fag end. A thicker vessel costs more than a thinner one. The sides of the pan are not directly affected by the heat. They may be thinner so that the pan may be lighter and cheaper.

(c) *The Size of the Boiling Pan* :— Unlike sugarcane juice the quantity of palm juice to be boiled cannot be fixed.

Mere fixing of the number of the tapped trees cannot help in furnishing uniform quantity of nira. Even individual trees do not yield the same amount of nira every day throughout the tapping period. During the first few days the yield is very small, and goes on increasing till about the middle of the tapping period and then decreases steadily, till the end of the tapping period. Therefore, the quantity of nira to be boiled is not the same from start to finish of the season, though the number of trees tapped be constant. Again all the trees do not behave uniformly. Some are early yielders and others are late yielders. This also augments the unsteadiness of the quantity to be boiled. So the size of the pan cannot be determined by considering either the minimum or maximum yield. If a pan of big size, capable of boiling the maximum quantity that can be obtained from a set of trees, is used, it will not do for boiling the smaller quantities obtained during the early stages, as the gur will get burnt, as it will not be enough to cover the bottom of the pan. On the contrary if a small pan is used to deal with the quantity obtained during the beginning, it cannot cope with the larger yields when the trees are in full flow. The via media is to have a pan of moderate size and to have more than one boilings instead of trying to boil the whole nira in one lot. In this way both, the smaller yield during the early and ending days, as well as the larger yields in the middle of the season, can be easily handled.

For finding out the quantity that can be boiled in a pan, the formula $\pi r^2 h$ = cft. contents (where $\pi = 22/7$ and cft = 62 lbs) used for determining the capacity of cylindrical vessels, may be employed. The level of the nira in the pan, when it is charged, should always be 4 inches. The height of the pan should always be 9 inches. Then if the diameter is

to the end of a bamboo of sufficient length to form a stirrer. Another small stirrer of the same type is also necessary.

(f) *Scrapers* :— Two small wooden scrapers, with short handles, for heaping and transferring the crystallized semi-solid gur from the wooden cooler into the moulds, are required, as also an iron scraper, fixed to a wooden handle, for scraping off gur clinging to the pan.

(g) *Bamboos and Baskets* :—Two bamboos are put across the pan to hold the basket, in which the scum is put for straining the nira into the pan below. A piece of cloth, enough to line the basket internally, and another small basket is required.

(h) *Wooden cooling Box* :— For emptying the viscous mass from the pan, shallow wooden box, (2' x 3½' x ½') open at the top, is needed. It is fixed in a well plastered rectangular pit on a level with the ground, so that when the boiling pan is lifted off the furnace, it can be rested vertically on the brink of the pit and the contents easily emptied into the cooling box. The box must be quite smooth inside.

(i) *Moulds* :—Moulds of any shape can be used and may be either wooden, metallic or earthen. In the case of big moulds three or four small holes should be left in the bottom for traces of mollasses left in the gur to trickle out.

Commonly village palm gur makers boil the nira in earthen pots. They use a wooden ladle for removing the scum, a frond of the palm petiole as stirrer, and a shell for scraping the gur from the pots. To them coconut shells serve the purpose of moulds. In some places a wooden board, in which small holes are carved, is used as a mould. These moulds are internally wetted with cold water before the hot gur is poured in. No separate pot is used for cooling the gur.

If more than one tappers are to work together, the diameter of the pan should be adjusted accordingly, keeping the depth of the pan constant *i. e.* 9 inches.

(d) *Earthen Vessels* :— If earthen vessels are to be used, their mouths ought to be as broad as possible to help rapid escape of vapour. It cannot get out briskly if narrow mouthed vessels are used. In Madras, the professional palm gur makers use narrow mouthed, deep, earthen vessels, as are used for boiling rice, to boil the nira. In Bengal broad mouthed earthen vessels are used for gur making. The South Indian palmyra gur maker uses four vessels at a time, placed over an oven, having four holes to hold them. The Bengali uses from one to six or even more pots at a time, depending on the quantity of nira to be boiled. One person can attend to four such vessels only. At least one person is needed to boil the nira drawn by one tapper, if such earthen vessels are used. But if flat, shallow, iron pans are used, one person will suffice to make gur out of nira drawn by four tappers. Considering that labour is cheap in villages, and that members of the tapper's family can do the boiling, and further that the cost of iron pans is high and that they are products of large scale manufacture, earthen pots, which are cheap and are easily made, and form part of the village economy, may be preferred in places where they can be made locally.

Skimmer :—

A perforated ladle (zara) about 9" broad, fixed to a wooden handle and with fine perforations, is necessary, the length of the handle depending upon the size of the pan.

(e) *Wooden Stirrer* :— A semi-circular wooden piece 8" x 4" x ½", the diametrical side being comparatively sharp, is fixed at the centre of the circumference at an acute angle

Where the ground is capable of standing fire, the furnace can be simply carved in the earth. But in black soil an earthen furnace does not work long. Bricks have to be used to build the furnace. While digging, allowance should be made for the space required for the bricks as the measurments are of the inside surface of the furnace. The same bricks can be used year after year.

(4) *Feeding of the Furnace* :— Too much fuel should not be put in at a time. It should be added in small succcessive instalments. The grating should be cleaned of ashes and embers with an iron hook fixed to a wooden handle. If the grating is choked, supply of fresh air is checked and the fuel does not burn well. Ashes should not be allowed to accumulate in the pit, the lower chamber of the furnace, for the same reason. A small iron rectangular shovel, fixed to a long wooden pole, may be used to take out the ashes from the pit.

(5) *Care of the Furnace* :— The pan should be well fixed on the top of the furnace so that no heat can escape through the sides. Dry ashes should be spread round where the furnace top and the pan bottom come together.

The inside of the upper chamber should be made as smooth as possible by mud plaster and no cracks should be left for the heat to escape.

A hole 6" x 6" should be left in the side of the chimney opposite the flue and closed with a removable brick. After a few days' interval this brick should be taken out and the soot formed inside the chimney scraped out with a stick.

Occasionally the furnace should be mud plastered.

(6) *Advantages of the Improved Furnace* :—

(1) The Improved Furnace saves fuel and thereby reduces the cost of gur production.

(j) *Furnace* :—

(1) *Country Furnace* :— In Bengal the palm gur furnace is made of earth partly in the ground and partly above it, while in Madras it is altogether above the ground. A pit about 4 ft. in diameter and 3 ft. deep is made. Two arches are built over it, dividing its area into four equal parts. These are then plastered so as to leave 4 circular holes over which the earthen pans can be placed. The diameter of the furnace is adjusted according to the number of pans to be placed. A rectangular furnace is more convenient if more than four pans are used. The pit has two apertures on opposite sides, one for feeding in fuel and the other for the smoke to escape. This type of furnace is not scientific, as the combustion of fuel is not complete and it is very difficult to control the fire when necessary. The consumption of fuel in this furnace is 1½ times that consumed in an improved furnace for the same quantity of juice.

(2) *Improved Furnace* :— A furnace must have an arrangement to allow a regular supply of fresh air to the burning fuel, an escape for the smoke and gases, and an escape for the ashes formed while the furnace is worked. To achieve these objects an improved furnace is fitted with a grating on which the fuel is burnt. Just below the grating a pit is provided for receiving the ashes dropping from the grate. This ash pit has a connection with a tunnel opening out side for supply of fresh air to the fuel. A flue and chimney are set to allow moke and gases to escape.

(3) *How to build a Furnace* :— On a level ground a line AB is drawn East to West or any suitable direction to prevent direct draught of wind in the feed hole, 25 ft. long. In the diagram the line is drawn East to West. Keeping this line in the centre, a trench CD 7" broad, 10" deep and 8' long is dug from B towards A. Then with a diameter 3" less

than that of the desired pan, a circle is drawn just touching D and a 2' deep pit is made of the size of the circle. Again, inside this pit another rectangular pit 2' long, 1½' broad, 2' deep, is dug, touching the Western side of the upper pit, so that the depth of the inner pit is 4' from the ground surface. In the same Western side, leaving a margin of 9" of ground, another pit 3' broad and 5' long is dug to supply fresh air and to enable removal of ashes. The ash pit is connected with this pit underground, by a hole 1' x 1½' in the wall of the furnace, at the bottom of the pit. This pit will have a slope rising towards A, to facilitate a continuous, steady supply of fresh air, which will enter through the grating placed over the top of the ash pit, and pass out through the flue and chimney.

In order to give the maximum heat to the pan, a baffle wall 1½' high and 3" broad is raised 9" away from the grating, inside the upper chamber of the furnace. It is raised in the shape of a semi-circular arch, and on either side a gap of 4" is left between this arch and the side of the furnace. Due to this wall the heat and flames cannot pass into the flue or the chimney without heating the pan. The trench is covered with bricks and well plastered. At the other end of the trench the chimney 1'x9" (internally) is raised to a height of 8'. A grating 2'x1½' is made of ½" round iron rods. Both the ends of the rods are beaten and rivetted to iron strips 1½" broad, ¼" thick. A gap of half an inch is left between every two rods. This grating is placed over the ash pit, inside the upper chamber of the furnace. Just opposite the flue, a round hole of 8" diameter is made in the wall over the grating, for putting in fuel. The big pit is then covered for 3 ft. from just below the feeding hole, with a plank, or pieces of bamboos, wood or tin and covered with earth, if necessary, so that fuel can be kept over it or the feeder can sit over it.

this the pan should be filled with nira upto 4" of its height, *i. e.* a pan having 9" depth should be filled upto 4" of its sides only. The upper 5" space is left for the nira to rise while boiling. Gur will be charred if the quantity of nira is too small.

(d) The fire should be controlled while removing the scum. Otherwise the scum gets split and mixed in the boiling nira and is very difficult to remove.

(e) The pan, the scum strainer, all ladles, moulds and every article used for gur making ought to be thoroughly cleaned daily.

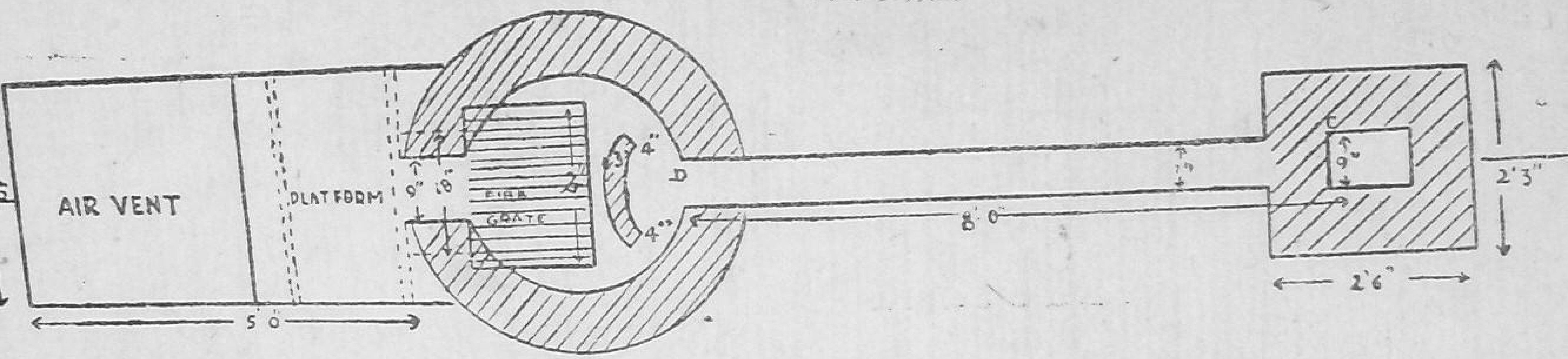
(f) The boiling is usually done in the open in the fields where the palms grow. It is necessary to take care to prevent dust and other foreign matter, blown by the wind, falling into the boiling juice. For this purpose a shed should be erected over the furnace and a pan with suitable screens used.

(g) Too much stirring destroys crystals in the gur. It should, therefore, be done lightly and must not amount to rubbing.

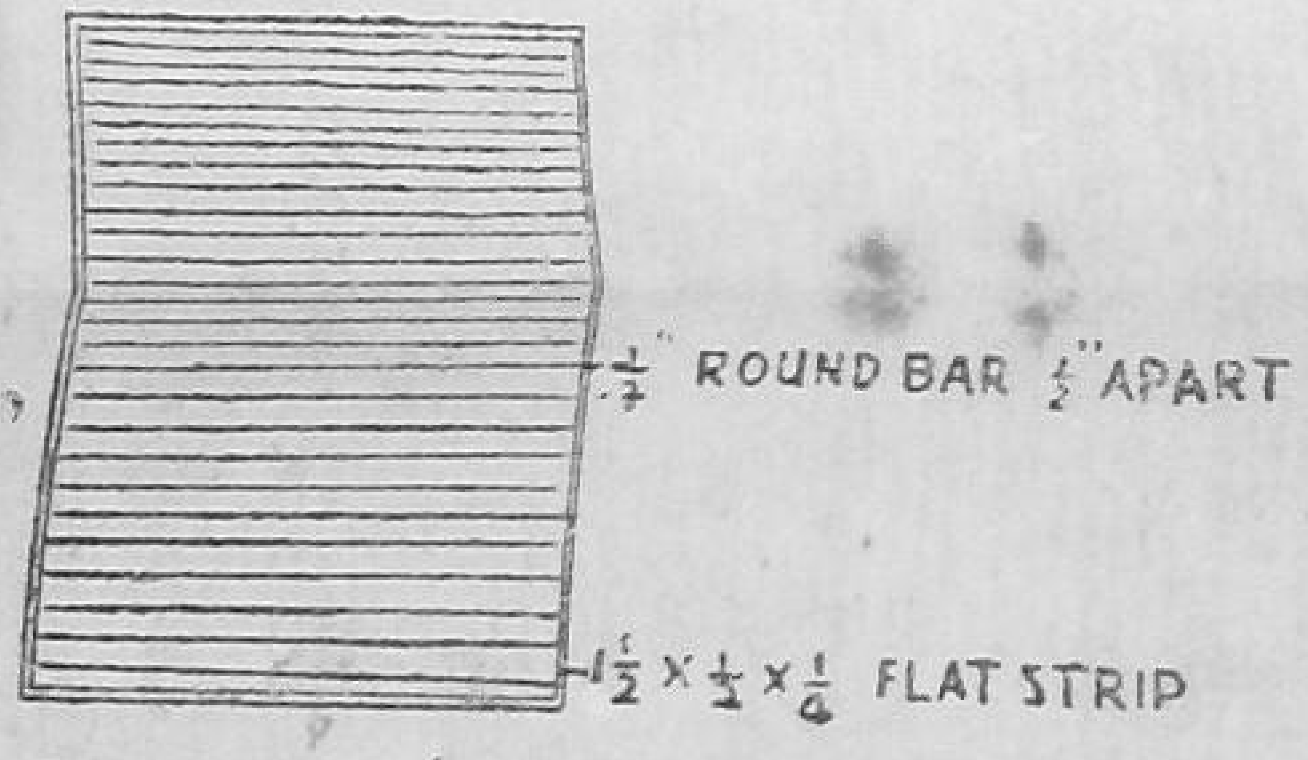
(h) Cooling of viscous mass should not be done rapidly as slow cooling augments formation of bigger crystals.

(i) The crystallized mass from the wooden cooler must be still hot and a little fluid when transferred to the moulds, in order to get a compact solid block of the desired shape. Cooled and solidified loose crystals will not form a compact homogeneous block, even if pressed into the mould, after being cooled.

NIRA BOILING FURNACE
(FOR 3' PAN)
SCALE 1" = 2'-0"
BY COURTESY OF DEPT
OF INDUSTRIES. U.P.

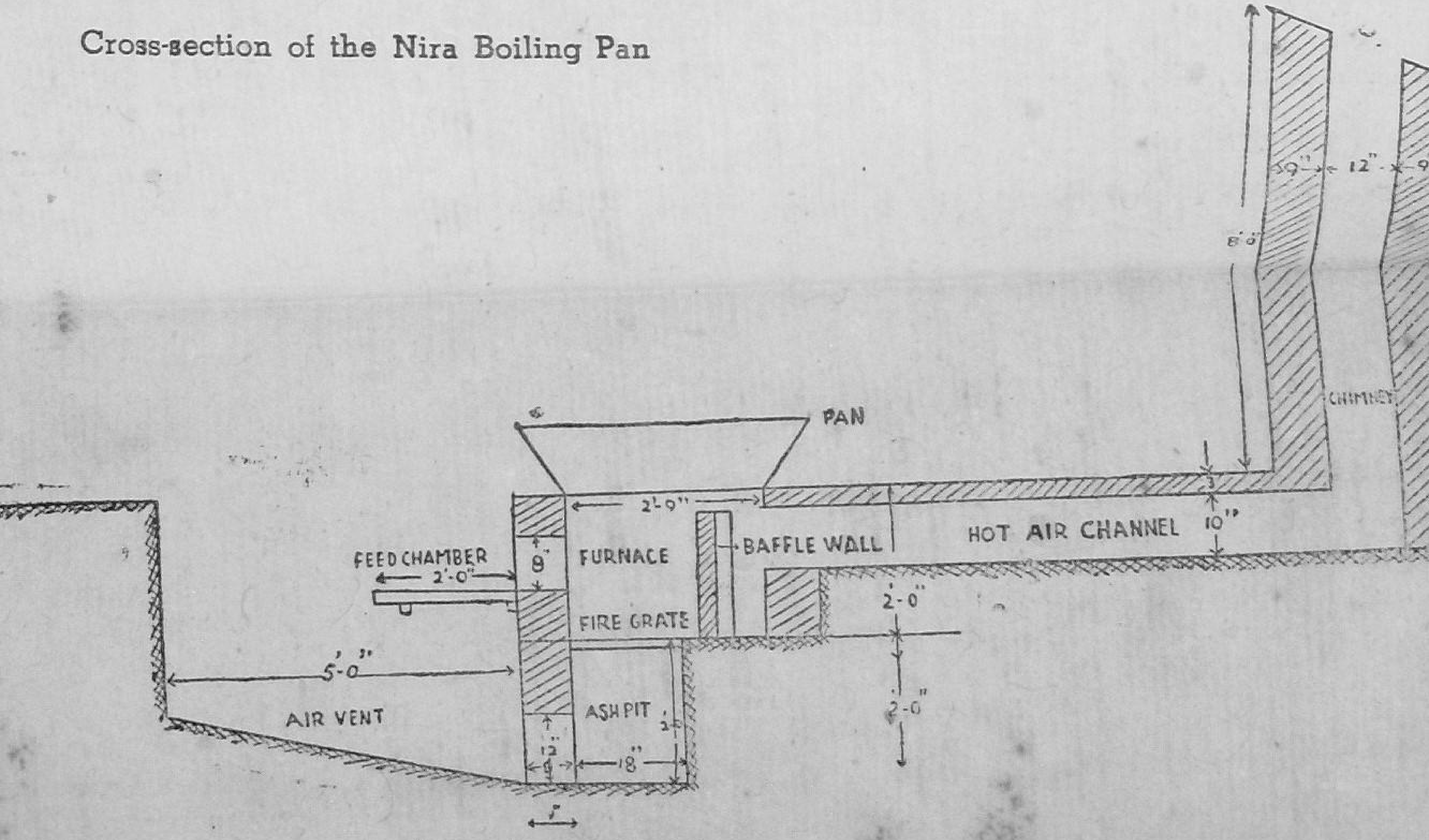


PLAN



FIRE GRATE
1'-6" x 2'-0"

Cross-section of the Nira Boiling Pan



SECTION ON AB

(2) It is quite convenient to work with as the gur makers are not troubled by smoke or heat as in the case of the ordinary furnace.

(3) It facilitates improvement in the quality of gur as there is very little charring which is experienced in ordinary furnaces.

(k) *Fuel* :— Logs of wood and such heavy fuel aro not useful for jaggery making. They leave embers and render it very difficult to control the heat at the finishing stages of boiling. Dried leaves, twigs, farm-yard rubbish, and such other light fuel is more useful, as they leave only ashes and the fire can be easily controlled. Leaves of palms make excellent fuel. Light fuel is preferable, also for the reason that for the rapid evaporation of water from the nira quick fire is essential. Heavy fuel gives slow and steady heat, useful only for cooking, but not for rapid boiling,

(iii) Precautionsn in Boiling

(a) The pan should first be placed on the furnace and the nira to be boiled put into it, and then alone the fire is to be lit. No juice should ever be added again during boiling at any stage.

(b) The side of the pan should be kept clean by using a wet piece of cloth. If any scum or juice burns on the side of the pan, the colour of the gur becomes blackish.

(c) The pan should not be filled to the brim with nira. The larger the quantity of nira the longer is the time required to make gur. If boiling is continued for a long period the quality of the gur is spoiled. It is essential to finish the boiling of each charge of the pan within 1½ to 2 hours. To achieve

this the pan should be filled with nira upto 4" of its height, i. e. a pan having 9" depth should be filled upto 4" of its sides only. The upper 5" space is left for the nira to rise while boiling. Gur will be charred if the quantity of nira is too small.

(d) The fire should be controlled while removing the scum. Otherwise the scum gets split and mixed in the boiling nira and is very difficult to remove.

(e) The pan, the scum strainer, all ladles, moulds and every article used for gur making ought to be thoroughly cleaned daily.

(f) The boiling is usually done in the open in the fields where the palms grow. It is necessary to take care to prevent dust and other foreign matter, blown by the wind, falling into the boiling juice. For this purpose a shed should be erected over the furnace and a pan with suitable screens used.

(g) Too much stirring destroys crystals in the gur. It should, therefore, be done lightly and must not amount to rubbing.

(h) Cooling of viscous mass should not be done rapidly as slow cooling augments formation of bigger crystals.

(i) The crystallized mass from the wooden cooler must be still hot and a little fluid when transferred to the moulds, in order to get a compact solid block of the desired shape. Cooled and solidified loose crystals will not form a compact homogeneous block, even if pressed into the mould, after being cooled.

VII. PRESERVATION OF PALM GUR

Palm Gur contains mineral salts like calcium, potassium etc. Like common salt, this gur is hygroscopic, *i. e.* under moist conditions it tends to become watery.

(i) Solid Gur in Dry Weather

The Gur should be kept in such a way as to have free contact with air, *i. e.* it should be exposed to the room temperature. If it is kept under cover, either in tins or wrappers it becomes moist as the air surrounding it becomes moist, due to fall of temperature.

(ii) Solid Gur in Wet Weather

On the contrary, in the wet season, when the atmosphere is surcharged with moisture, the gur has to be kept in a place where the air is dried by heat, say on the hearth, as is done by villagers, or in an air-tight place. Only a small quantity can be kept over the hearth and even thus there is risk of the gur becoming moist. Solid blocks of Palm gur, wrapped in gunny cloth or palm leaf mat, or small balls in bags or baskets, should be placed in cotton seeds, just before the wet season starts. A layer, about a foot thick, of cotton seeds of requisite dimensions should be spread over the floor, the gur blocks or baskets placed over the layer, and covered with another layer at least 4'' thick. Over the top of this a line of more blocks or baskets can be similarly arranged. Care should be taken to make the whole structure quite compact by pressing the seeds firmly and allowing no gaps when the layers are laid. This method is quite effective, handy and almost costless. The gur remains in tact in spite of the wet season. Cotton seeds can be easily had in villages. They are not in any way damaged

because of such use. They can be sold at the end of the season. In addition, the process is ant-proof, as ants do not attack the gur while it is in the seeds. The scientific reason of this behaviour of cotton seeds seems to be as under. The seeds retain small fibres of cotton even after ginning. When a number of seeds are pressed in a compact mass, a wall of these fibres is formed and this obstructs the passage of outside moist air to the gur inside. A similar experience from ordinary life corroborates this. When a layer of loose cotton is spread between two pieces of cloth and stitched over crosswise, as in a quilt (razai), it keeps the body more warm than a woollen cloth of the same thickness.

Individual blocks or containers from the preserved stock can be removed whenever required, taking care not to disturb the rest.

Of course the above method is not economically feasible in transit. So enough gur will have to be stocked before the wet season starts.

(iii) Liquid Gur

In the dry or wet season there are very little chances of such gur being spoiled. Still it is advisable to be cautious. Usually porous earthen pots are used for storing such gur. It will be better to use lacquered earthen pots, as they are non-porous. Gur is filled in upto the neck when still warm, and the mouth sealed. It will be advantageous to keep such gur pots submerged in cotton seeds, if possible, during the wet season.

Gur, solid or liquid, can last for a year, if properly kept.

VIII NUTRITIVE VALUE OF PALM GUR

Figures are taken from the data collected by Sjt. Kalidas Mitra, I/C Nutrition Research Scheme, Patna.

The following tables will give an idea of the nutritive value of Palm gur and its comparison with sugarcane gur and sugar.

TABLE VII A.

S. No.	Item	Moisture	Protein	Fat	Carbo hydrates	Cane sugar	Glucose
1	Cane sugar	0.04	—	—	—	99.70	Nil
2	Cane gur	8.86	0.25	0.05	89.84	—	—
3	Palmyra gur	8.32	1.04	0.19	87.29	76.86	1.66
4	Date Palm ,,	9.16	1.46	0.26	86.07	72.01	1.48
5	Sago ,, ,,	9.16	2.28	0.11	84.89	84.31	0.53
6	Coconut ,,	10.32	0.96	0.15	30.53	71.89	3.70

TABLE VII B.

Chief Mineral Elements per 100 gms. of material.

S. No.	Item	Total Minerals gms.	Calcium gms.	Phosphorus gms.
1	Refined cane sugar	1.02	Nil	Nil
2	Sugar cane Gur	1.00	0.400	0.045
3	Palmyra Gur	3.15	0.861	0.052
4	Date Palm Gur	2 60	0.363	0.062
5	Sago Palm „	3.66	1.352	0.372
6	Coconut Palm „	5.04	1.638	0.062

TABLE VIII

Presence of Vitamins per 100 Gms. of the stuff.

No.	Item	Units of Vitamin B_1	Units of Vitamin B_2
1	Date Palm molasses	24.3	17.3
2	Cane molasses	10.4	2.7

Molasses = Semi Solid Gur.

H. G. Biswas,
Chemist, Bengal Chemical &
Pharmaceutical Works, Ltd.

IX. ECONOMICS OF THE INDUSTRY

(i) Introductory

The industry of Palm gur, as it exists in India, has different features. In some places it is a full time occupation during certain months of the year. In other tracts it is merely one of the subsidiary daily activities of the agriculturists. Thus in South India, there is a class of palmyra tappers, whose main occupation is gur making during the season. But the manufacture of coconut palm gur, though carried out throughout the year, is merely a daily subsidiary work of the Malabar farmer. It is wonderful that both in Madras and in Bengal there is a uniform division of labour involved in this industry. The work on the palm, tapping and lowering nira, is done by men, while boiling nira into gur is done by women, either at home or on the farm. This is unlike cane gur making, which is done by men alone. Since the industry is conducted in villages by illiterate people, no authentic statistics of the economics of the industry can be had from them. The figures in the following tables are given from experience gained by educated workers at trial centres. The yield of nira depends on local climatic conditions, skill of the tappers, soil etc. In the same way the cost of fuel and labour varies in different localities. These figures, therefore, are meant only to give a fair idea of the industry and need not be exepcted to hold good under all circumstances. Figures for Sago are not available.

The Price Factor :— The economics of the industry are, of course, governed by the price commanded by gur. It varies according to the quality of the gur and the local tastes. In Madras, Palmyra gur sells at about 16 lbs. per rupee retail and about 25 lbs. per rupee wholesale, Coconut gur is sold at

1 a. 3 ps. per lb. and sago at 1 a. per lb. In Bengal the semi-solid gur is sold cheap from 2 to 3 as. per seer, while solid gur, locally called Patali, fetches a higher price, even upto Rs. 2 per seer. In new areas, where it is recently introduced (C. P., Orissa, U. P.), it is sold at about -/3/- per seer

(ii) Income Per Tapper

The following figures show that a tapper may earn about Rs. 10/- per month through this industry.

TABLE IX A.

INCOME AND EXPENDITURE OF COCONUT PALM GUR INDUSTRY

(As practised in South Indian Villages)

(i) No. of trees tapped by one tapper in the season—25
(ii) Average daily yield of nira per tree—3½ lbs.
(iii) Yield of jaggery on nira— 25%.

Monthly Returns

(From a tapper's point of view)

Income	Particulars	Expenses
		Rs.
Rs. 16-0-0	By sale of 16 mds. gur @ Rs. 1 per md.	
0-5-0	Income from nuts	
	Tree rent for 25 trees	3- 2-0
	Furnace, Pan etc.	0- 4-0
	Fuel	3- 0- 0
	Appliances	0- 1- 6
	Miscellaneous	0- 2- 3
	Lime and earthen pots	0-11- 3
Rs. 16-5-0	Total	7-5-0

	Total Income	Rs. 16-5-0
Less	" expenses	7-5-0
	Earnings	9-0-0

(*By the Leather Research Chemist, Department of Industries Madras*).

TABLE IX-B.

INCOME AND EXPENDITURE OF DATE-PALM GUR INDUSTRY

(1) Total No. of trees tapped ... 220

(2) ... Nira obtained ...16690 Seers

(3) ... Gur obtained ... 1700 „

(4) Yield of jaggery on nira 10%

(5) Duration of season ... 4 months.

Seasonal Returns

(From a tapper's point of view)

Income	Particulars	Expenses
Rs. 352-8-0	By sale of 42 mds. gur @ 8/12/-per maund.	
	To tree rent of 220 trees	Rs. 55- 0 -0
	Furnace	4 8 -9
	Fuel	46-14-3
	Appliances	3-15-6
	Lime and earthen pots	12-13-6
	Pan boilers and other labour	36- 7 -9
	Miscellaneous	19-11-6
Rs. 352-8-0	Total	179-7-3

Income	352-8-0	
Less expenses	179-7-3	
Earnings	173- 0-9	of 4 tappers
Earning	43- 0-0	per tapper for 4 months
"	10-13-0	per tapper per month

(*A. I. V. I. A. Tuljapur Centre, Wardha C. P. 1941-42 season*)

TABLE IX- C,

(*Figures relate to pre- war period*)

INCOME AND EXPENDITURE OF PALMYRA GUR INDUSTRY

(i) No, of trees tapped–30 per day; 60 per season,
(Male trees tapped in the first half and female in the second)
(ii) Yield of jaggery 5000 lbs.
(iii) Dura tion of season 135 days,

Seasonal Returns

(From a tapper's point of view)

Income	Particulars	Expenses
Rs, 200-0-0	By sale of 5000 lbs, gur @ 25 lbs. per rupee	
	Tree rent @ -/8/- for 60 trees	Rs. 30-0-0
	Pan	5-0-0
	Lime	4-0-0
	Pots	6-0-0
	Fuel	30-0-0
	Appliances	1-0-0
	Pan Boiler for 135 days	42-3-0
	Miscellaneous	6-0-0
	C, F,	124-0-0

200-0-	B. F.	124-0-0
	Commission to middleman @ Rs. 2 per candy of 500 lbs.	20-[illegible]-0
	Interest on Rs. 30 (Advance taken) @ 18%	1-8-0
Rs. 200-0-	Total	145-11-0

Income	...	200- 0-0
Less Expenses	...	145-11-0
Earnings		55- 5-0 in 4½ month.
"		Rs. 12- 0-0 per month per tapper.

(Leather Research Chemist, Department of Industries, Madras, Experiment at Novdur, West Godavari Dist. in 1930)

The Sago Palm

The Sago palm yields large quantities of nira. It is said to yield 90 to 125 gallons of nira during the season. Since the tapping is rather laborious, one tapper can tap up to 10 trees only. In India the tappers do not conduct Sago palm Gur making as a full time industry. The gur is made in Malabar (Madras Presidency) where the trees are grown in coconut gardens. The farmers tap one or two trees during spare hours and the nira is boiled at home by the women-folk, along with household cooking. The gur is easily disposed of locally. The yield of gur on nira is about 11 per cent.

X. GOVERNMENT PERMISSION

Palms have been misused by man by converting its sweet nutritious natural sap (nira) into intoxicating toddy. The alien rulers have made capital out of this human weakness. Toddy trade has been legalised and made a source of much revenue at the cost of the ignorant masses. In spite of modern communications, the cult of Palm gur has remained confined to Madras and Bengal, though there are thousands of palms capable of yielding sugar in other provinces. For safeguarding the excise revenue, the tapping of sugar yielding palms had been prohibited, even for gur making, in all provinces except Madras and Bengal. In some provinces it was allowed under unbearable excise tax.

(i) Full Freedom

At present permission for tapping any kind of sugar yielding palm for the purpose of manufacturing gur or consuming or selling the nira drawn as a beverage, is not required to be taken in Bengal, Orissa or the wet districts of the Madras Presidency.

(ii) Freedom through License

In the dry districts of Madras and in the whole of C. P. and Berar, tapping of any kind of sugar yielding palm for the manufacture of gur or the consumption or sale of nira is allowed under a free licence. In C. P., only for nira sales, a nominal fee is charged.

In Madras the applications need not have stamps affixed, while in the C. P., a twelve anna revenue stamp has to be affixed to the application. In Madras, the applications are

to be submitted and licenses issused by any Revenue Officer above the grade of the Revenue Circle Inspector. In C. P. the applications are to be submitted to and licenses issued by only the Deputy Commissioner of the District. The licenses are issued annually. The kind and number of palms and the village where tapping and gur making is proposed to be conducted, have to be mentioned in the application. No tree tax is levied as for fermented toddy drawing nor are any charges made for supervision.

(iii) Retarding Restrictions

In Bombay and Bihar, the rules provide for a free licence without tree tax, but payment of excise supervision charges is made obligatory for the tapping of palms for gur making. The District Revenue Collector and the Excise Superintendent are the licensing authorities in the respective province.

In other provinces there are no precise rules allowing tapping of palms for gur. The following table will give an idea of the conditions at a glance—

TABLE X

DETAILS OF PROVINCIAL EXCISE RULES

S. N.	Province	Full freedom	Freedom under licence (free)	Licenoc under supervision tax	Dis allowed
1	Assam				X
2	Bengal	X			
3	Bihar			X	
4	Bombay			X	
5	C. P.		X		
6	Madras	XW	XD		
7	N. W. F. P.				X
8	Orissa	X			
9	Punjab				X
10	Sind				X
11	U. P.				

XI. IMPORTANT FEATURES OF THE INDUSTR Y

(1) It is a cent per cen: village industry

All the accessories *viz.* tapping tools, pots and pans, etc, and the lime required to arrest fermenting of nira, can be made or obtained locally by the villagers. So that they can be quite self-dependent in carrying on the industry of palm gur,

(2) It turns waste into wealth

Lakhs of Date, Palmyra and Sago palms grow naturally in many places, on uncultivable lands and on field bunds and are at present practically going to waste. They require no nursing and if only tapped for the purpose, thousands of tons of gur and sugar can be obtained from them annually.

(3) It can be carried on widely

Sugar yielding palms of one or more varieties are found growing naturally or are capable of being cultivated all over the country. In many parts where the palms exist, skilled labour for tapping them is available in abundance. If only gur making is taught, the industry can be wide spread, as it has been, for centuries, in Bengal and Madras.

(4) It requires only a small investment

An initial capital ranging from Rs. 10 to 50 is enough to start the industry.

(5) Its technique is simple

A novice can pick up gur making in a month, and tapping and gur making in six months.

(6) It meets a universal demand

The need for gur or sugar exists everywhere, and the villages, which are near palm groves, can be made self-sufficient in regard to their gur needs, and extra produce of gur can be distributed to neighbouring needy villages or towns.

(7) It produces a nutritious food article

Palm-gur contains minerals useful for the human system such as calcium, potassium, magnesium, phosphorus, etc. Minerals are essential for growth and health. It is a tonic for pregnant women and has curative medical properties.

(8) It is a counter part of prohibition

Under prohibition of intoxicants, the palms cannot be used for toddy drawing and the erstwhile tappers will be rendered jobless. But if this industry is taken up, the trees can be utilized and the tappers employed once more. It will also serve to effect a sociological change of outlook amongst the toddy addicts by teaching them a benificial method of utilizing the palms.

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Childrens' Text Book on Diet *By J. P. Patel*	(H)	1- 0-0	0 2-0

3. INDUSTRIES

Oil Extraction *By J. P. Patel*	(E) (H)	3- 0-0	0-4-0
4th Edition ,,			
The Oil Mill vs. The Ghani (A Chapter from Oil Extraction)	(E) (H)	0- 2-0	0-4-0

Palm Gur *By G. B. Naik*	(E) (H)	1-0-0	0-2-0
Bee Keeping	(E) (H)	2-0-0	0-2-0
Soap Making *By K. B. Joshi*	(E)(H)	1-8-0	0-2-0
Paper Making *By K. B. Joshi*	(E)(H)	4-0-0	0-4-0
Grinding of Cereals	(E)	0-8-0	0-2-0
Magan Chula	(E) (H)	0-8-0	0-1-0
Magan Dipa	(E)	0-8-0	0-1-0
Dhotijama	(H)	0-2-0	0-1-0

(Out of one Dhoti two garments—"Dhoti jamas"—can be made thus halving the cost. This pamphlet describes how it is made.)

4. SURVEY

* **C. P. Government Industrial Survey Committee Reports**

(Under the Chairmanship of J. C. Kumarappa)

Gandhiji writes :—

"Chapter 2 dealing with general considerations stamps the report as an original document and shows that it is not to be pigeon-holed as most such reports are, but should be given effect to without delay."

"The committee has made practical suggestions on all the industries. The curious must procure the report and study it.

Part I. Vol 1. pp. 50 General recommendations to Government based on a survey of 606 villages.	(E)	0-8-0	0-4-0
Part I Vol 2. pp. 132 Two selected District Survey Reports and Notes on 24 Village Industries	(E)	1-0-0	0-4-0
Part II. Vol 1. pp. 40 Recommendations in regard to Forest, Mineral and Power Resources	(E)	0-8-0	0-4-0
Part II. Vol 2 pp. 109 Selected portions of reports on Forests, Mineral and Power resources, and on Transport, Taxation and Marketing	(E)	0-12-0	0-4-0

* **A Plan for the Economic Development of the N. W. F. Province, pp.36** (with supplement)

By J. C. Kumarappa (E) 0-13-0 0-3-0

Sir Mirza Ismail writes:—"I should like to compliment you on the very lucid manner in which you have dealt with the various questions relating to the industrial development of the Province. You have approached the whole problem in a direct, matter-of-fact and eminently practical way".

* **Survey of Matar Taluka**

By J. C. Kumarappa (in press) (E)

Kaka Saheb Kalelkar writes:—"The report is presented to the public as an authoritative document on the economic condition of a typical taluka of Gujarat. The reader will find that the statistics presented here in careful schedules are even more eloquent than the main body of the carefully worded and lucid report itself. It is a vivid picture of the slow process of exploitation, emasculation and perhaps decimating of a patient and peaceful population".

A Questionnaire for Rural Survey (E) (H) 0-4-0 0-1-0

A Questionnaire for the Survey of Village Industries (E) 1-8-0 0-4-0

5 SUNDRIES

A Guide to Maganvadi (E) (H) 0-3-0 0-1-0

Views of Maganvadi (28 pictures) (E) (H) 0-8-0 0-4-0

6 MISCELLANEOUS

Public Finance and Our Poverty

By J. C. Kumarappa

3rd Edition

with a foreword by Gandhiji * (E) 1-8-0 0-2-0
(H) 2-8-0 0-4-0

Gandhiji says:—

"The reader should carefully study these chapters which contain facts rather than arguments."

"I recommend the booklet both to the Indian as also to the Western readers."

The "Hindu" says:—

" The outspokenness of the analysis of the Indian problem is reinforced by revealing statistics in the book. The book deserves to be read by every student of Indian Economics."

*** Practice & Precepts of Jesus** (E) 1-8-0 0-2-0

By J. C. Kumarappa

Gandhiji says:—

" Having carefully gone through these chapters, I can recommend their perusal to every believer in God, be he a Christian or a follower of any other religion.........It is a revolutionary view of Jesus as a man of God......If all believe, as Prof. Kumarappa does, there will be no religious feuds and rivalries between sects and sects and different religions.

The Missionary Journal "Dnyanodaya" says:—

"We trust our readers will not fail to pray that the spirit of Christ, who led Prof: Kumarappa to write it, will bless its many readers......to read it is a searching spiritual exercise... the shining sincerity reflected on every page of this book makes it a benediction to read."

*** Christianity:—**

Its Economy and Way of Life (E) 1-8-0 0-2-0

By J. C. Kumarappa

This is a critical examination of the economic order of the West in the light of the principles enunciated by Jesus.

Organization and Accounts of Relief Work

By J. C. Kumarappa 1-0-0 0-2-0

Dr. Rajendra Prasad says.—

"This pamphlet summarises and collects and collates our experience and method of work (in Bihar Earthquake Relief) and Sri J. C. Kumarappa has done a public service in bringing together the points which may appear obvious now, but which were not so obvious when we started, and which needed much thought to make them clear. I hope it will prove helpful not only to new organizations engaged in similar work but also to students and would be organizers. and social workers.

*Clive to Keynes	(E)	0-12-0	0-1-0
By J. C. Kumarappa	(H)	0- 8-0	0-1-0
	(G)	0-10-0	0-1-0

(A survey of the history of our Public Debts and Sterling Securities)

The "Hindustan Times" says:—

The brochure is packed with information which will have to be borne in mind when it comes to final reckoning with Britain."

Sterling Securities	(H)	0- 4-0	0-1-0
By J. C. Kumarappa			
* **Stone Walls & Iron Bars**	(E)	0-14-0	0-2-0
By J. C. Kumarappa			

(Gives an account of the jail experiences of the writer and his suggestions of reform).